CLAIMS

1.   A symbol point estimating apparatus that estimates a symbol point of a received signal by determining a time delay between a sampling point of the received signal sampled at a sampling frequency, and the symbol point of the received signal, comprising:

a multiplication/sum of products output means that outputs a sum of products of respective products obtained by multiplying a complex conjugate of a frequency component of an ideal signal and a frequency component of the received signal and a sampling angular frequency; and

a time delay determining means that determines a time delay to minimize an error component between the ideal signal and the received signal based on the output of said multiplication/sum of products output means.

2.   The symbol point estimating apparatus according to claim 1, wherein:

said multiplication/sum of products output means comprises:

a frequency component product output means that outputs the product of the complex conjugate of the frequency component of the ideal signal and the frequency component of the received signal; and

a sum of products output means that outputs the sum of products of the respective outputs of said frequency component product output means and the sampling angular frequency.

3.   The symbol point estimating apparatus according to claim 2, wherein:

said frequency component product output means comprises:

an ideal signal frequency component output means that outputs the frequency component of the ideal signal;

a received signal frequency component output means that outputs the frequency component of the received signal;

a complex conjugate output means that outputs the complex conjugate of the output of said ideal signal frequency component output means; and

a frequency component product output means that multiplies the output of said complex conjugate output means and the output of said received signal frequency component output means by each other, and then outputs a result of the multiplication.

4.   The symbol point estimating apparatus according to claim 2, wherein:

said frequency component product output means comprises:

a convolution output means that outputs a convolution of the complex conjugate of the ideal signal and the received signal; and

a frequency component output means that outputs a frequency component of the output of said convolution output means.

5.   The symbol point estimating apparatus according to claim 2, wherein:

said sum of products output means comprises:

a real part sum of products output means that outputs a sum of products of the real part of the respective outputs of said frequency component product output means and the sampling angular frequency;

an imaginary part sum of products output means that outputs a sum of products of the imaginary part of the respective outputs of said frequency component product output means and the sampling angular frequency; and

a complex number output means that outputs a complex number whose real part is the output of said real part sum of products output means and whose imaginary part is the output of said imaginary part sum of products output means.

6. The symbol point estimating apparatus according to claim 1, wherein:

said time delay determining means determines the time delay based on the argument of the output of said multiplication/sum of products output means, the sampling angular frequency, and an error calculation length which is the number of the components of the received signal used to calculate the error component.

7. The symbol point estimating apparatus according to claim 6, wherein:

said time delay determining means comprises:

an argument output means that receives the output of said multiplication/sum of products output means, and outputs the argument thereof; and

a time delay calculating means that calculates the time delay based on the output of said argument output means, the sampling angular frequency, and the error calculation length.

8. A symbol point estimating method that estimates a symbol point of a

received signal by determining a time delay between a sampling point of the received signal sampled at a sampling frequency, and the symbol point of the received signal, comprising:

a multiplication/sum of products output step of outputting a sum of products of respective products obtained by multiplying a complex conjugate of a frequency component of an ideal signal and a frequency component of the received signal and a sampling angular frequency; and

a time delay determining step of determining a time delay to minimize an error component between the ideal signal and the received signal based on the output of said multiplication/sum of products output step.

9.   A program of instructions for execution by the computer to perform a symbol point estimating process that estimates a symbol point of a received signal by determining a time delay between a sampling point of the received signal sampled at a sampling frequency, and the symbol point of the received signal, said symbol point estimating process comprising:

a multiplication/sum of products output step of outputting a sum of products of respective products obtained by multiplying a complex conjugate of a frequency component of an ideal signal and a frequency component of the received signal and a sampling angular frequency; and

a time delay determining step of determining a time delay to minimize an error component between the ideal signal and the received signal based on the output of said multiplication/sum of products output step.

10.   A computer-readable medium having a program of instructions for

execution by the computer to perform a symbol point estimating process that estimates a symbol point of a received signal by determining a time delay between a sampling point of the received signal sampled at a sampling frequency, and the symbol point of the received signal, said symbol point estimating process comprising:

a multiplication/sum of products output step of outputting a sum of products of respective products obtained by multiplying a complex conjugate of a frequency component of an ideal signal and a frequency component of the received signal and a sampling angular frequency; and

a time delay determining step of determining a time delay to minimize an error component between the ideal signal and the received signal based on the output of said multiplication/sum of products output step.